

BELLCOMM, INC.

955 L'ENFANT PLAZA NORTH, S.W.

WASHINGTON, D. C. 20024

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SUBJECT: Lunar Orbital Science Experiments
Sample Timeline and Preliminary
Power Consumption Analysis for
the Typical J-Mission - Case 320

DATE: March 26, 1970

FROM: G. J. McPherson, Jr.

MEMORANDUM FOR FILE

A sample timeline and preliminary power consumption data (Attachments 1-4) were provided to W. Scott, Jr. of the MSC Mission Planning and Analysis Division (MPAD) in the form of working papers on March 2, 1970. The need for such information had been identified in conversations between Scott and the writer. It was intended that the data be used for preliminary power profile and cryo consumption analyses until more accurate data becomes available from North American-Rockwell.

The information provided to MSC was for the CSM-112 (Apollo 16) orbital science instrument configuration, but without the recently added subsatellite. The sample timeline (Attachment 1) was based on the 15.3 day typical J-mission, which allocated 72 hours for orbital science.* For simplicity, the timeline disregarded instrument operation prior to Scientific Instrument Module (SIM) door jettison (i.e. launch phase requirements, instrument warm-up) and assumed continuous instrument operation throughout the 72 hour period except where it was prohibited by hardware limitations or operational constraints. Representative instrument operate times were assumed for the transearth coast (TEC) phase.

Attachments 2-4 reflect, respectively: the estimated power requirement values used for the power consumption analysis, and their source; the power consumption based on the sample timeline; and the resultant power profile. The power consumption calculations of Attachment 3 indicate that a total of 33.2 kilowatt-hours of electrical energy would be required to support equipment unique to orbital science data acquisition: ~29.1 kilowatt-hours during the orbital phase and ~4.1 kilowatt-hours during the TEC phase. Attachment 3 also indicates that the average amperage during the orbital and TEC phases would be ~13.4 amperes and ~1.4 amperes, respectively.

*Memorandum for File, 15.3 Day Typical Mission Timeline and Design Mission Maximum Phase Durations for the Apollo J-Missions, G. J. McPherson, Jr., Bellcomm, February 11, 1970.

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(NASA-CR-112697) LUNAR ORBITAL SCIENCE
EXPERIMENTS SAMPLE TIMELINE AND PRELIMINARY
POWER CONSUMPTION ANALYSIS FOR THE TYPICAL
J-MISSION (Bellcomm, Inc.) 6 P

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The power profile of Attachment 4 provides insight into the maximum steady state loads that would be expected. The steady state loads reach their maximum value of ~24.2 amperes each time the 24" Panoramic Camera is in the operate mode.

While recent developments (i.e. revised power requirements for the instruments, clarification of hardware and operational constraints) have somewhat decreased the accuracy of both the sample timeline and the power consumption calculations, it is felt that the total power consumption values remain valid enough to make the following observations:

1. The total energy consumed by equipment unique to orbital science data acquisition could be significantly more than the 22 kilowatt-hours previously assumed by MSC for preliminary power profile analyses.
2. The maximum steady state load of ~24.2 amperes is significantly higher than previously anticipated and could be cause for concern.*
3. Better defined instrument power requirements and a new timeline tailored to anticipated rather than maximum instrument operation are needed to allow more meaningful analyses.

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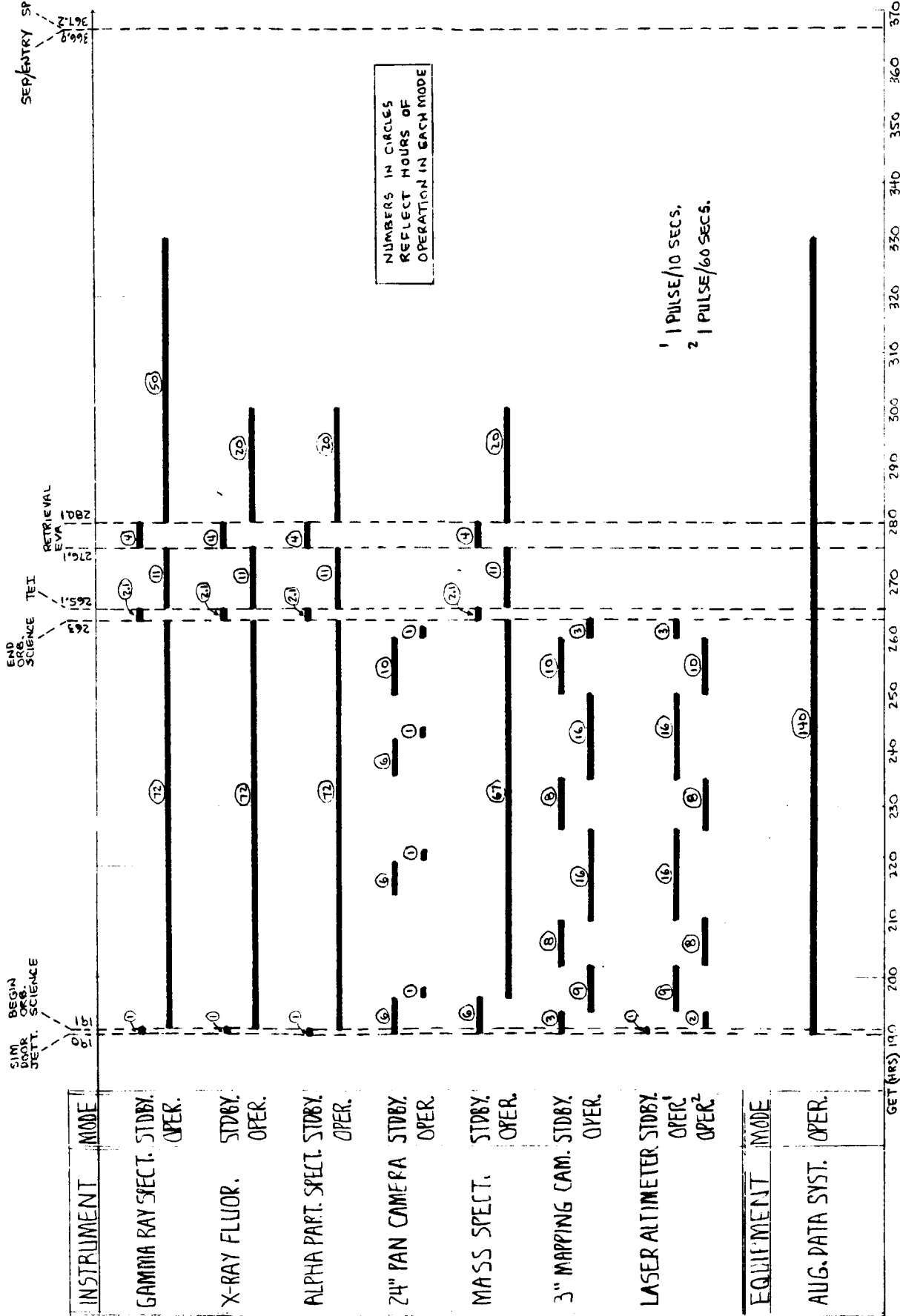

G. J. McPherson, Jr.

Attachments 1-4

*Hardware changes have recently been approved to alleviate potential CSM power problems. Reference: Memorandum for File, Potential CSM Power Problems for the J-Mission, G. J. McPherson, Jr., Bellcomm, March 25, 1970.



SEP/ENTRY SPLASH.



APOLLO 16 EXPERIMENTS-SAMPLE TIMELINE

ATTACHMENT 1

G.J. McPHERSON, JR.
Bellcomm 2/20/70

INSTRUMENT / EQUIPMENT	AVERAGE DC POWER (WATTS)	
	STANDBY	OPERATE
GAMMA RAY SPECTROMETER	12.0 ¹	7.2 ²
X-RAY FLUORESCENCE	15.0 ¹	19.8 ²
ALPHA PARTICLE SPECTROMETER	2.5 ¹	6.7 ²
24" PAN CAMERA	416.8 ³	460.7 ³
MASS SPECTROMETER	3.0 ¹	13.0 ⁴
3" MAPPING CAMERA	60.0 ¹	100.0 ⁴
LASER ALTIMETER (1 PULSE/10 SECS) (1 PULSE/60 SECS)	20.0 ¹	59.5 ⁴ 29.5 ⁴
AUGMENTED DATA SYSTEM	—	35.0 ⁵

¹ THE WRITER ASSUMED A 60% HEATER DUTY CYCLE AND APPLIED IT TO "STANDBY VALUES" EXTRACTED FROM EITHER DESIGN REVIEW MEETINGS OR THE REFERENCE BELOW. IT SHOULD BE NOTED THAT THIS APPROACH WAS QUITE ARBITRARY.

² AVERAGE VALUES QUOTED AT DESIGN REVIEWS.

³ ESTIMATED VALUES OBTAINED FROM MSC VIA TELECON.

⁴ AVERAGE VALUES EXTRACTED FROM THE REFERENCE BELOW.

⁵ BASED ON VALUES IN PRELIMINARY PROCUREMENT SPECS.

REFERENCE: NORTH AMERICAN-ROCKWELL INTERNAL LETTER 695-105-110-69-102,
ALEM EXPERIMENT SUMMARIES (REVISION 2), DATED NOVEMBER 18, 1969.

ESTIMATED POWER REQUIREMENTS
ATTACHMENT 2

INSTRUMENT/EQUIPMENT	MODE	AVE. PWR. (WATTS)	HOURS IN EACH MODE			ENERGY CONSUMED IN EACH MODE		
			DOOR JETT. THRU TEI	TEI THRU ENTRY	DOOR JETT. THRU ENTRY	DOOR JETT. THRU TEI	TEI THRU ENTRY	DOOR JETT. THRU ENTRY
GAMMA RAY SPECTROMETER	STANDBY	12.0	3.1	4.0	7.1	37.2	48.0	85.2
	OPERATE	7.2	72.0	61.0	133.0	518.4	439.2	957.6
X-RAY FLUORESCENCE	STANDBY	15.0	3.1	4.0	7.1	46.5	60.0	106.5
	OPERATE	19.8	72.0	31.0	103.0	1425.6	613.8	2039.4
ALPHA PARTICLE SPECT.	STANDBY	2.5	3.1	4.0	7.1	7.75	10.0	17.75
	OPERATE	6.7	72.0	31.0	103.0	482.4	207.7	690.1
24" PAN CAMERA	STANDBY	416.8	28.0	—	28.0	11670.4	—	11670.4
	OPERATE	460.7	4.0	—	4.0	1842.8	—	1842.8
MASS SPECTROMETER	STANDBY	3.0	8.1	4.0	12.1	24.3	12.0	36.3
	OPERATE	13.0	67.0	31.0	98.0	871.0	403.0	1274.0
3" MAPPING CAMERA	STANDBY	60.0	29.0	—	29.0	1740.0	—	1740.0
	OPERATE	100.0	14.0	—	14.0	4400.0	—	4400.0
LASER ALTIMETER	STANDBY	20.0	1.0	—	1.0	20.0	—	20.0
	OPERATE ¹	59.5	44.0	—	44.0	2618.0	—	2618.0
	OPERATE ²	29.5	28.0	—	28.0	826.0	—	826.0
AUGMENTED DATA SYST.	OPERATE	35.0	75.1	65.0	140.1	2628.5	2275.0	4903.5
			TOTAL WATT-HOURS			29158.85	4068.70	33227.55
* IN WATT-HOURS			AVERAGE WATTAGE			388.27	39.97	
** AT 29 VOLTS			AVERAGE AMPERAGE			13.39	1.38	

* 1 PULSE 10 SECS.
** 1 PULSE 60 SECS.

